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Into the Urban Wild: Collection of wild urban plants for food and medicine in Kampala, Uganda

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Abstract:
In sub-Saharan Africa, many people depend on natural resources for their livelihoods. While urbanisation causes landscape changes, little is known of how this process affects the use of wild plant resources by urban populations. This study contributes to addressing this knowledge gap by exploring the prevalence and determinants of urban collectors of wild plants in Kampala, Uganda. During February to August 2015, 93 structured interviews were conducted in inner, outer, and peri-urban areas of the city. The findings in this study show that urban wild plants are used by almost half (47%) of the respondents, mainly for medicinal purposes but also as a complement to diets. The findings further indicate that residents with lower income, of younger age (<51 years old), and predominantly living in peri-urban areas are more likely to be urban collectors. Seasonality appears to be of greater importance in collection of food plants than of medicinal plants. Overall, these findings indicate that wild plants occupy an important role in the livelihoods and traditions of Kampala's residents, and we argue that this should be taken into account in urban planning projects.

Highlights

- We explored the prevalence and determinants of urban wild plant collection in Kampala.
- Nearly half of the respondents collected urban wild plants.
- Predictive variables of wild plant collectors are wealth status, age and location.
- The majority of wild plants collected are used as medicine.
- Food plant collection appears to be more seasonal.

Keywords: livelihoods, natural resource management, non-timber forest products, safety net, urban ecosystems, human ecology

1. Introduction

Urban collection of wild plants is a subject that has received scant attention in studies of natural resource usage and conservation. There is therefore very little understanding of its prevalence and determinants. However, the body of evidence on the importance of wild plants in rural peoples livelihoods in developing countries is growing, and it is recognised that non-cultivated plants are highly valued as a strategy to combat food insecurity, dietary deficiencies (Arnold et al., 2011; Mahapatra and Panda, 2012; Powell et al., 2011; Vinceti et al., 2013) and alleviate poverty (Oteng-Yeboah et al., 2011; S. Shackleton et al., 2011; Sunderland and Ndoye, 2004). They also play an important role in maintaining and improving health in different settings (e.g. McMullin et al., 2012; Pouliot, 2011).

African countries have some of the highest urbanisation rates and it is estimated that 50% of Africa's population will be living in urban areas by 2030 (Montgomery, 2008; The World Bank, 2015). In a region that is already severely affected by demographic, political and economic challenges, urban development plans need rethinking to accommodate the population in a sustainable way (UN Habitat, 2014). Effects of climate change and the rise of unplanned informal settlements cause pressure on urban natural vegetation (Cohen, 2006; The World Bank, 2015). Thus, urbanisation affects local biodiversity (McKinney, 2008), directly through land cover change, or indirectly by changing ecosystem and biogeochemical processes (Alberti, 2008).

Along with loss of local biodiversity comes a change in the use of wild plant resources. This is frequently seen as erosion of traditional knowledge and has been assumed to be particularly

prevalent in the urban environment, where global influences, market availability of exotic species and loss of biodiversity pose a threat to traditional knowledge systems (Sogbohossou et al., 2015; Vandebroek et al., 2011). Nevertheless, market studies show that the interest in wild plant species does not disappear as people move from rural to urban areas (e.g. (Barirega et al., 2012; McMullin et al., 2012; Sneyd, 2013; van Andel et al., 2012; Vandebroek and Balick, 2012)). Household studies on urban consumption of wild plants, however, are much rarer. Still, the scant evidence on the topic can provide some insights into consumer profiles and their underlying motivations for consuming wild plants, as well as provide information on the state of traditional knowledge of urban residents (Oreagba et al., 2011; Schlesinger et al., 2015). For example, a study conducted in Suriname in 2006 (van Andel and Carvalheiro, 2013) showed that 66% of the urban population use wild medicinal plants (mostly self-collected in their own garden or neighbourhood) and that its consumption is neither linked to poverty nor to limited access to allopathic healthcare. Health status and traditional knowledge are instead the strongest explanatory variables of medicinal plant consumption in the urban study area. Qualitative evidence from Yaoundé, Cameroon, shows that wild food plants are important ingredients for the preparation of commonly-prepared traditional dishes (Sneyd, 2013).

These studies demonstrate that the use of wild plants still play important roles in the lives of urban residents, but say little about sources of these plants. In fact, only a few authors discuss sources of wild plants outside of markets such as wild collection. While wild collection of plant species in *rural* communities has been studied extensively (e.g. (Cunningham, 2001; Pouliot, 2011; Tabuti and Damme, 2012; Vinceti et al., 2013)), there is only very little empirical evidence showing that *urban* collection of wild species occurs (e.g. (Davenport et al., 2011; Furukawa et al., 2016; Kaoma and C. M. Shackleton, 2014; McLain et al., 2013; Schlesinger et al., 2015)). Yet, urban collection can be considered a "deeply relational practice connecting humans with nature, other humans and their inner selves" (McLain et al., 2013, p. 12). Moreover it is a form of preserving cultural identity, it provides free medicines and adds to food security as a safety net preventing people from falling deeper into poverty in times of hardship (e.g. unexpected shocks and crises) (Davenport et al., 2011). In an urbanising world, where traditional knowledge systems and biodiversity are threatened, this is a field that deserves more attention (Penafiel et al., 2011; Sneyd, 2013).

Studies conducted in Southern Africa by Davenport (2011), Kaoma (2014) and Schlesinger (2015) all focused on the use of wild natural resources in medium sized towns and cities (Davenport et al., 2011; Kaoma and C. M. Shackleton, 2014; Schlesinger et al., 2015). These locations are all fast growing and important because there are still opportunities for planning interventions. The findings of Davenport et al. (2011) indicate that town size determines the intensity of wild plant collection practices, as they found 27% of the population in larger towns versus 70% in smaller towns to be urban collectors (Davenport et al., 2011). However Schlesinger et al. (2015) did not find any relationship between size of town and prevalence of wild plant collection in urban areas (Schlesinger et al., 2015). Instead, they found that the importance of urban collection of wild plants is related to the location of the household in the urban to peri-urban continuum; they attribute this to the higher share of land covered by vegetation in peri-urban areas. As these peri-urban areas are prone to near-future developments and urbanization, their role in local livelihoods needs to be understood before unsustainable and (un)planned development ensues (Davenport et al., 2012; Vermeiren et al., 2013).

While the use of wild plants still has an important role in peoples' livelihoods through traditional medicines and food culture, it is important to understand where in the urban and peri-urban environment wild plant collection takes place in order for public policy to

incorporate the land use practice in its designs, including the food security agenda. In addition to understanding the characteristics of urban collection - the who, where and when – it is important to understand how collection of wild plants is perceived, as public perception can be an important determining factor (Tabuti and Damme, 2012). For example, if collection of wild plants is a socially accepted practice, it can form a driver in conducting the practice, while a negative view may inhibit people to collect wild plants, at least in plain sight. Understanding these subtleties can immensely improve effective policy design (Walker et al., 2013).

This paper aims to explore the scope of collection of wild plants in Kampala, Uganda. Moreover, it investigates the determinants associated with the collection of wild plant species in an urban context. This study aims to answer 5 research questions:

(1) What characterises collectors of wild urban plants?
(2) Which plants are collected and for what use?
(3) Where and in what type of locations (public or private) does urban collection take place in the urban and peri-urban environment?
(4) Does urban collection of wild plants function as a safety net?
(5) What are people's attitudes and perceptions regarding urban collection?

2. Methods

2.1 Definition of concepts

Three words can be used to describe the concept we discuss: collecting, gathering and foraging. In this paper we use the term "urban collection", however different authors have used various concepts that have similar definitions, such as "urban gathering" or "urban foraging" (of which the latter implies collection of food products) (McLain et al., 2013) and "the use of urban commons" or "commonages" (which is a broader concept and refers to lands available to the public, including everything that grows on it) (Davenport et al., 2011).

Wild plants grow within a spectrum of human involvement (Cruz-Garcia and Price 2014; Wiersum, 1997). The plants grow on vacant lots and on roadsides as well as landscaped areas such as parks and gardens. They are mainly wild, non-altered species, but also include "feral" cultivars. Feral plants are those that have grown without any human intervention, and can include plants that are technically cultivars but were not intentionally planted (McLain et al., 2013). This phenomenon is quite common in urban areas, where high levels of organic waste causes cultivars to take root and grow into productive plants. More specifically, in the context of our study we focus on plants used for food and/or medicine within these urban landscapes and refer to the practice as urban collection of wild plants. We further specified our definition for wild plants included in this study as plants that: (1) can come from any part of the landscape other than the respondent's own garden, and (2) have minimal to no involvement of human management such as cultivation or pruning etc. by the collector.

Attitude and perception are closely related concepts, that are dynamic in time and can influence each other and their behavioural outputs. While attitude is "a psychological tendency that is expressed by evaluating a particular entity with some degree of favour or disfavour", perception can be understood as "a process of interpretation by which individuals ascribe meaning to things" (Eagly and Chaiken 1993). We use both these concepts to interpret how the respondents regard urban collection.

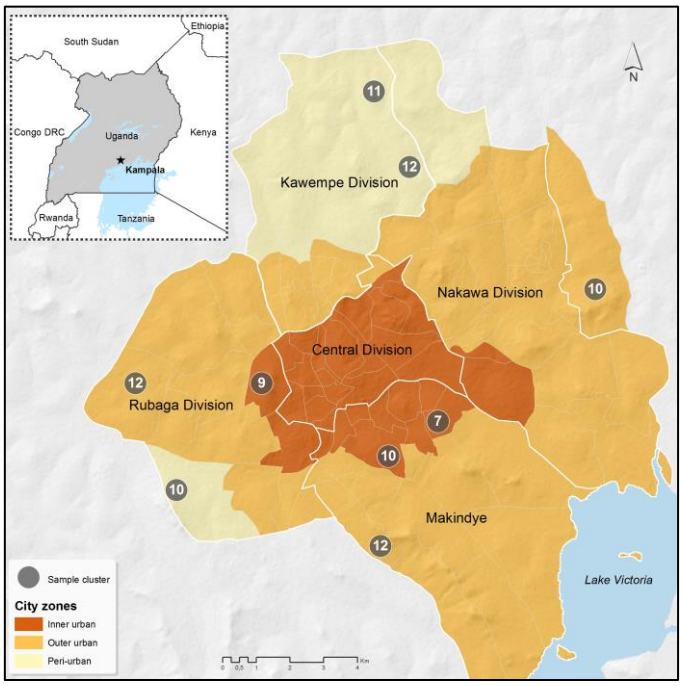

Figure 1 Map of Kampala, Uganda with inner-, outer- and peri-urban areas indicated. The nine cluster sampling sites are indicated with the grey dots. The numbers within the dots show the number of households included in this study at each cluster site.

2.2 Study area and population

Data collection for this study took place in Kampala, Uganda between February and August 2015 (0°19'N, 32°35'E) (Figure 1). Over the past three decades, Kampala has experienced an annual growth rate of about 4% to its current population level of almost 1.9 million inhabitants (CIA, 2016). This has caused the city to increase the total built-up area from 71 km^2 to 386 km^2 (Vermeiren et al., 2012) and hence led to the disappearance of much of the city's green areas (Vermeiren et al., 2013).

2.3 Sampling and Data Collection

Since this study was part of a larger project that focuses on child nutrition and urban plant diversity, the target study population for this paper are low-income urban homegarden-farming households with at least one child (2-6 years old). Three residential area typologies (inner-, outer- and peri-urban) were derived from classifications by Kampala Capital City Authority physical development plan (KCCA, 2012). These classifications were based on location and proximity to the city as well as population density. Next, a two-staged cluster sampling was applied. Within each area, three parishes (clusters) were selected based on the following criteria: residential area characteristics, homegarden pervasiveness and lower level income neighbourhoods. The inner urban areas included Namirembe, Kabalagala and Nsambya/Lukuli with an average population density of 301 people per hectare, the outer urban parishes included Busega, Kireka and Luwafu with an average population density of 115 people per hectare, and lastly, with an average of 60 people per hectare, Kyanja, Kikaya, and Mutundwe were included from the peri-urban area (UBOS, 2014). Within each parish, 9 to 13 households were then purposively selected based on the presence of a homegarden, a child and an available respondent. The aims of our study were explained to respondent and consent was sought.

Overall, 93 households were included in this study. The households who agreed to take part were visited twice. The first visit covered general household information through structured questionnaires, such as the number of household members, geographical origin of household members, and income sources and assets, while the second visit focused on species collected by the

household during the six months prior to the interview (6 month recall period), and included questions about attitudes and perceptions of the use and collection of wild plants. Due to the ambiguity in recall studies (i.e. Jagger et al. 2012), a 6 month recall period was preferred because it is considered more reliable than a 1 year recall period, yet still captured both a wet and a dry season. Both questionnaires were pretested and the interviewers were trained in conducting the survey prior to the visits. They were all native bilingual Ugandans who were able to conduct the interviews in the local language, Luganda. Additional data collected were GPS coordinates and residential (homestead) plot size.

An adapted free listing technique was used for recollection of collection activities (Weller and Romney, 1988) and in addition the respondent was guided by resource categories to help them remember the wild plants collected (Cavendish 2002). Information on the use of wild plants, purpose (private or commercial), source, month(s) and frequency of collection was recorded. Only the primary use of a species was recorded.

A Multidimensional Poverty Index tool (Henry et al., 2003) was used to calibrate relative poverty within the sample group by conducting a principal component analysis (PCA) on multiple poverty indicators such as household assets, housing structures and income sources. Household food insecurity was determined with the Household Food Insecurity Access Scale (HFIAS) (Coates et al., 2007), which is an approach to measure experiences of household food insecurity through survey questions which is summarised in four scales, from severe food insecurity to high food security.

Table 1 Description and expected influence of independent variables and household attributes used in the analyses.

Variable	Expected influence on the frequency of wild plan collection activities
Sex of the respondent	Women collect more wild plants than men as they traditionally are the main collectors of wild plants in Uganda (Agea et al., 2011a; Barirega et al., 2012; Ojelel and Kakudidi, 2015).
Elder respondent (above 50)	Elderly people collect more plants as they have more time and knowledge of useful wild plants than younger people (Ojelel and Kakudidi, 2015; Tabuti and Damme, 2012; Tugume et al., 2016).
Education	People with a higher education level are more likely to choose allopathic health services (Pouliot, 2011), and are thus less likely to collect plants from the wild for medicinal use. In South Africa, low levels of education was significantly correlated with wild plant collection in two out of three towns studied (Davenport et al., 2011).
Wealth status	Lower income households are more dependent on wild plant resources for (subsistence) income (Jagger, 2012; Kaoma and C. M. Shackleton, 2015; S. Shackleton et al., 2011) which can potentially help mitigate urban poverty (Davenport et al., 2011), whilst wealthier households that are part of a more formal economy have better access to markets to buy commodities such as food and medicine due to higher cash income. They have more choice in types of food and medicine, and, according to a study in Uganda, prefer allopathic medicine above traditional medicinal plants (Tabuti et al., 2003a).
Household food insecurity	Households that are more food insecure feel a higher need to collect from the wild to complement their diet (Kaoma and C. M. Shackleton, 2014).
Household size	Larger households tend to be poorer and are therefore more likely to feel the need to collect wild plants (Ssewanyana, 2009). They also have higher labour availability, which they can use to collect wild plants.
Urban or rural	Collection of wild plants is more common in rural areas than in urban areas (Davenport et al.,

background respondent	2011; Kaoma and C. M. Shackleton, 2014). People with rural backgrounds are therefore more likely to possess traditional knowledge of wild plants (Tabuti and Damme, 2012) and will be more inclined to collect wild plants in the urban landscape.
Location in Kampala	Peri-urban areas are less densely populated and more abundant in wild plants than inner urban areas (Schlesinger et al., 2015).
Plot size household	Larger gardens (plots) lead to more food security (Mwangi, 1995), hence reduces the need for wild plant collection.

2.4 Model and Analysis

We used a binomial Generalized Linear Model (GLM) to determine whether respondent and household variables have any predictive value over a respondent's decision to collect wild plant species (Table 1). More specifically we used the Probit model, which is a special link function in the GLM. We used logistic regressions to find out whether the amount of land owned had an effect on the location of wild food collection (i.e. private or public land).

The Probit regression analysis as well as other descriptive statistical analyses were conducted with STATA/13.

3. Results

3.1 Characterisation of urban collectors

In total, 44 of the 93 respondents (47%) reported collecting wild plants in urban areas during the six months covered by the survey period (Table 2). The results show that respondents under the age of 51 as well as respondents with a lower household income are more likely to report collecting wild plants in Kampala than other households (Table 3).

Table 2 Characteristics of households and urban collectors included in the study.

Variables	All households interviewed (n=93)		Urban collectors (n=44)	
	Continuous variables	Categorical variables	Continuous variables	Categorical variables
	Mean ± S.D.	Obs[(a)] (%n)	Mean ± S.D.	Obs[(a)] (%n)
Sex				
Female		81 (87%)		38 (86%)
Male		12 (13%)		6 (14%)
Elder respondent (above 50)		25 (27%)		4 (9%)
Education				
No formal schooling		6 (6%)		4 (9%)
Lower primary		8 (9%)		4 (9%)
Upper primary		30 (32%)		15 (34%)
Secondary O level		29 (31%)		13 (30%)
Secondary A level		7 (8%)		1 (2%)
Vocational school		4 (4%)		3 (7%)
Tertiary		4 (4%)		2 (5%)
University		5 (5%)		2 (5%)
Wealth status				
Poorest		23 (25%)		15 (34%)
Below average		23 (25%)		14 (32%)

Just above average		22 (24%)	3 (7%)
Highest wealth status in sampling group		23 (25%)	10 (23%)
Household Food Insecurity Access Scale			
Highly food secure		11 (12%)	6 (14%)
Mildly food insecure		24 (26%)	9 (20%)
Moderately food insecure		26 (28%)	12 (27%)
Severely food insecure		32 (34%)	17 (39%)
Household size	6.9 ±3.1		6.8 ±2.8
Urban or rural background respondent			
Rural		67 (72%)	32 (73%)
Urban		15 (16%)	7 (16%)
Semi/peri urban		11 (12%)	5 (11%)
Location in Kampala			
Inner		26 (28%)	11 (25%)
Outer		34 (37%)	12 (27%)
Peri-urban		33 (35%)	21 (48%)
Plot size household[(b)]	0.104 ±0.077		0.099 ±0.089

[(a)]Obs = number of observations

[(b)] Household plot size was measured in hectares and included built structures.

Table 3 Probit results of determinants of urban collection of wild plants in Kampala, Uganda

Variables	Coefficient	*P*-value
Respondent is female	0.012	0.980
Resident in inner Kampala	0.533	0.172
Elder respondent (above 50)	-1.654	**0.000**
Education level of respondent (in years)	-0.082	0.389
Wealth index score	-0.372	**0.018**
HFIAS category	-0.149	0.401
Household size (number of people)	-0.012	0.811
Household has migrated from a rural area	0.186	0.570
Resident in Peri Urban area	0.818	**0.022**
Size of household plots (ha)	-0.127	0.948
Constant	0.431	0.631
LR $c^2(11) = 28.38$		
Prob > $c^2 = 0.0016$		
Pseudo $R^2 = 0.2228$		

3.2 Species collected

A total of 48 plant species (from 25 families) were recorded (Table 4). Of these plants 52% are collected for medicinal uses and 48% for food (12 fruit species, 3 leafy green vegetables, 1 other vegetables, 3 condiments (spices and teas), 3 types of pulses and 1 cereal). The plants originated from naturally generated populations ('wild' – this was mainly the case of medicinal herbs) or were 'feral' cultivar plants; the latter were plants which had taken root from organic waste or in some cases (mainly fruit trees and shrubs) had previously been planted but were abandoned or managed by neighbours (Table 4). Among the urban collectors, 10 collected only food plants, 20 collected only medicinal plants, and 14 respondents collected both food and medicinal plants. Moreover, 63% of all plant collection events reported are for medicinal use, and 37% for food. This study could not identify any factors determining whether a household collects food or medicinal plants.

Overall 50% of the plant species are considered indigenous and 50% exotic. Food plants collected include the more common fruit tree species such as jackfruit (*Artocarpus heterophylus* Lam.), guave (*Psidium guajava* L.), mango (*Mangifera indica* L.) and avocado (*Persea americana* Mill.), but also indigenous fruit species such as Madagascar cardamom (*Aframomum angustifolium* (Sonn.) K.Schum.) and Spanish tamarind (*Vangueria apiculata* K.Schum). Fruit species were mentioned more often than leafy green vegetables, even though the leafy green vegetable *Amaranthus dubius* Mart. Ex Thell. was mentioned by eight respondents and has the highest citation rate for food species in this study.

The most cited medicinal plant species are *Momordica foetida* Schumach. *Vernonia amygdalina* Delile, *Hoslundia opposita* Vahl, black Jack (*Bidens pilosa* L.), aloe (*Aloe Vera* (L.) Burm.f.) and little ironweed (*Cyanthillium cinereum* (L.) H.Rob), and can all be considered indigenous or naturalized.

The mean number of plant species collected per household was 2.5 (s.d. ±1.5) and ranged between 1 and 8. All plants were collected for own use only, which means that none of them were collected for marketing purposes.

Table 4 Wild plant species collected in Kampala by respondents (species are sorted by frequency of response).

Botanical family	Botanical name	Vernacular names[a]	Use[b]	Total collection citations	Indigenous /Exotic[c]	Wild type[d]
Cucurbitaceae	*Momordica foetida* Schumach.	Bbombo (Lu)	M	14	I	F/W
Asteraceae	*Vernonia amygdalina* Delile	Mululuuza (Lu)	M	11	I	F/W
Amaranthaceae	*Amaranthus dubius* Mart. Ex Thell.	Doodo (Lu)	F	8	E	F/W
Lamiaceae	*Hoslundia opposita* Vahl	Kamunye (Lu)	M	8	I	F/W
Asteraceae	*Bidens pilosa* L.	Black Jack (En), Ssere (Lu)	M	6	E	W
Asteraceae	*Cyanthillium cinereum* (L.) H.Rob.	Little ironweed (En), Kayayaana (Lu)	M	4	I	F/W
Moraceae	*Artocarpus heterophylus* Lam.	Jackfruit (En), Ffene (Lu)	F	4	E	F
Xanthorrhoeaceae	*Aloe Vera* (L.) Burm.f.	Aloe (En), Kigagi (Lu)	M	4	E	F/W
Amaranthaceae	*Chenopodium opulifolium* Schrad. Ex W.D.J.Koch & Ziz	Mwetango (Lu)	M	3	I	W
Myrtaceae	*Psidium guajava* L.	Guava (En), Ppeera (Lu)	F	3	E	F
Amaranthaceae	*Aerva lanata* (L.) Juss.	Lweza (Lu)	M	2	I	W
Anacardiaceae	*Mangifera indica* L.	Mango (En), Muyembe (Lu)	F	2	E	F
Asteraceae	*Ageratum conyzoides* (L.) L.	Namirembe (Lu)	M	2	E	W
Lamiaceae	*Ocimum gratissimum* L.	Wild Basil (En), Mujaaja (Lu)	F	2	I	F/W
Lamiaceae	*Plectranthus amboinicus* (Lour.) Spreng.	Kamubiri (Lu)	M	2	I	W

Lauraceae	*Persea americana* Mill.	Avocado (En), Ovakedo (Lu)	F	2	E	F
Poaceae	*Cymbopogon citratus* (DC.) Stapf	Lemongrass (En), Kisubi (Lu)	F	2	E	F/W
Solanaceae	*Capsicum annuum* L.	Chili pepper (Eng), Kamulali (Lu)	F	2	E	F
Zingiberaceae	*Aframomum angustifolium* (Sonn.) K.Schum.	Madagascar cardamom (En), Matungulu (Lu)	F	2	I	W
Acanthaceae	*Justicia exigua* S. Moore	Kazunzanjuki (Lu)	M	1	I	W
Arecaceae	*Cocos nucifera* L.	Coconut (En), Ebinazi (Lu)	F	1	E	F
Aristolochiaceae	*Aristolochia littoralis* Parodi	Nakasero (Lu)	M	1	E	W
Asteraceae	*Bothriocline longipes (Oliv. & Hiern) N.E.Br.*	Twatwa (Lu)	M	1	I	W
Asteraceae	*Emilia discifolia* (Oliv.) C.Jeffrey	Mukasa (Lu)	M	1	I	W
Asteraceae	*Solanecio mannii* (Hook.f.) C.Jeffrey	Kiralankuba (Lu)	M	1	I	W
Asteraceae	*Vernonia auriculifera* Hiern	Kikookooma (Lu)	M	1	I	W
Cleomaceae	*Cleome gynandra* L.	Jjobyo (Lu)	F	1	I	W
Crassulaceae	*Kalanchoe densiflora* Rolfe	Kiyondo (Lu)	M	1	I	F/W
Cucurbitaceae	*Cucurbita maxima* Duchesne	Pumpkin leaves (En), Suunsa (Lu)	F	1	E	F
Fabaceae	*Cajanus cajan (L.) Millsp.*	Pigeon peas (EN), Nkoolimbo (Lu)	F	1	E	F
Fabaceae	*Phaseolus lunatus* L.	Lima beans (En), Kayindiyindi (Lu)	F	1	E	F
Fabaceae	*Phaseolus vulgaris* L.	Common beans (En), Kijanjaalo (Lu)	F	1	E	F
Lamiaceae	*Leonotis nepetifolia* (L.) R.Br.	Lion's ear (En), Kifumufumu (Lu)	M	1	I	W
Lamiaceae	*Leucas martinicensis* (Jacq.) R.Br.	Mavigabakulu (Lu)	M	1	I	W
Lamiaceae	*Mentha aquatica* (L.)	Mint (En), Nabbugira (Lu)	M	1	I	W
Lamiaceae	*Ocimum forsskaolii* Benth.	Kakubajjiri (Lu)	M	1	E	W
Malvaceae	*Hibiscus sabdariffa* L.	Rosella (En), Musaayi gwadeezi (Lu), Kisayisayi (Lu)	M	1	I	F/W
Malvaceae	*Melochia corchorifolia* L.	Chocolate weed (En), Keyeyo (Lu)	M	1	I	W
Musaceae	*Musa* spp.	Banana (En)	F	1	E	F
Myrtaceae	*Callistemon citrinus* (Curtis) Skeels	Bottlebrush (En), Mwambalabutonnya (Lu)	M	1	E	F/W
Myrtaceae	*Eugenia capensis* (Eckl. & Zeyh.) Harv.	Surinam cherry (En), Nsaali (Lu)	F	1	E	F/W

Oxalidaceae	*Averrhoa carambola* L.	Starfruit (En)	F	1	E	F
Passifloraceae	*Passiflora edulis* Sims.	Passionfruit (En), Katunda (Lu)	F	1	E	F
Poaceae	*Zea mays* L.	Maize (En), Kasooli (Lu)	F	1	E	F
Polygonaceae	*Rumex usambarensis* (Dammer) Dammer	Kisekeseke (Lu)	M	1	I	F/W
Rubiaceae	*Vangueria apiculata* K.Schum.	Spanish tamarind (En), Tugunda (Lu)	F	1	I	F/W
Rutaceae	*Citrus limon* (L.) Osbeck	Lemon (En), Nniimu (Lu)	F	1	E	F
Solanaceae	*Solanum anguivi* Lam.	Green Uganda Pea Eggplant (En), Katunkuma (Lu)	F	1	I	F/W

[a]Vernacular names: En = English, Lu = Luganda
[b]Primary use of plant species: F = Food, M = Medicinal
[c]Species: I = Indigenous, E = Exotic
[d]Wild type: F=Feral, W= Wild, W/F=Can be either feral or wild
Note: All botanical names are accepted names according to The Plantlist: http://www.theplantlist.org/.

3.3 Collection locations

In total, 41% of the respondents who reported collecting urban wild plants did so on private land only, 39% collected only from public land, and 16% collected both from public and private land (and 5% of the respondents declined to name the source or didn't know). Results of a logistic regression show households owning larger parcels of land are more likely to practice urban collection only on private land (p-value=0.080) and less likely to collect on public land (p-value=0.018). Location of residence also influences the source of wild plants collected: people residing in peri-urban areas are more likely to collect only from public lands than other households (p-value=0.018) and people residing in inner Kampala are more likely to collect from private land only (p-value=0.080).

3.4 Seasonality

Most wild plants were collected less than once per week during the reported months of collection (Figure 2). This was especially true for medicinal plants. However, 8% of the food plants were collected daily.

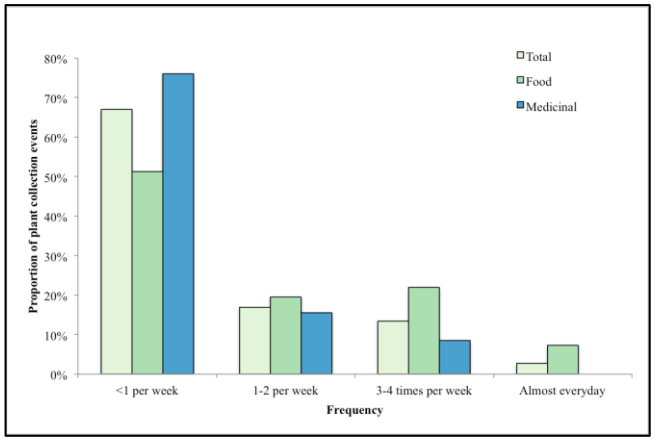

Figure 2 Frequency of plant collection events for food plants, medicinal plants and combined (Total).

A peak in collection events is found in March for both food and medicinal wild plants (Figure 3). Wild plant collection is lower during the rainy season and appears higher during the dry season.

However during the six months of the recall period, seasonal variation is higher for food plant collection events than for medicinal plant collection events.

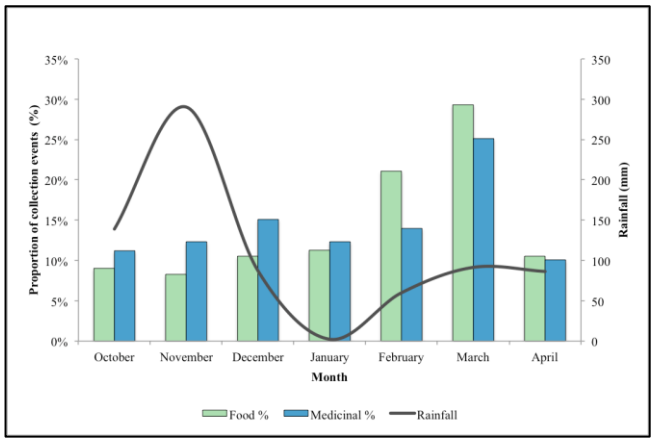

Figure 3 Relative number of plant collection events during the months of recall in percentages with rainfall data (Makerere Meteorological Station, 2016). Numbers are frequency adjusted.

3.5 Attitudes and Perceptions

There is no significant difference in attitudes and perceptions towards urban collection between practitioners and non-practitioners (Table 5). Only three respondents, of whom one is an urban collector, think it is shameful or embarrassing to collect wild plants in the city. However, comments such as "people are no longer friendly" [to allow people to collect from their plots] and "as long as it is not on someone's land" indicate that wild plant collection is limited to certain areas in the urban landscape. Even though the respondents in general have a positive attitude towards the practice of urban collecting, pollution gives them concerns: some avoid collecting leafy green vegetables, especially grown along the roadside, due to dust and other forms of pollution.

Table 5: Attitudes and perceptions regarding wild plant collection for all households[(a)] (n=83) and for urban collectors (n=43).

Statement	Agrees with statement	
	All households Obs[(b)] (%n)	Urban collectors Obs[(b)] (%n)
1. It is an important way to feed my family, especially in times of low production (insecurity/out of necessity).	23 (28%)	14 (32%)
2. Why would I pay, if I can collect it for free?	76 (92%)	43 (98%)
3. These products are not available at the market or they are very expensive.	1 (1%)	1 (2%)
4. I know these products from my village.	27 (33%)	20 (45%)
5. These products have essential nutrients for health.	25 (30%)	18 (41%)
6. Nature is my pharmacy.	50 (60%)	31 (70%)
7. I use them to diversify my family's diet.	25 (30%)	17 (39%)
8. They are not healthy because of pollution.	24 (29%)	8 (18%)
9. They are foods for the poor.	3 (4%)	3 (7%)

[(a)]Not all 93 households were available for this part of the study, so only 83 households were included in this part of the analysis.
[(b)]Obs = number of observations

This indicates that 28% of all respondents agree with the statement that wild plants are not healthy due to pollution (statement 8), however it is important to note that all respondents who agreed with

the statement also made additional comments in which they stated that vegetables (especially the road side leafy green vegetables) are polluted. Furthermore, only 4% of the respondents believe that wild food plants are for poor people only.

Of the respondents who agreed that it is an important way to feed their family, especially in times of low production or otherwise food insecure periods, only 14 (32%) considered themselves urban collectors. Nine respondents agree with the statement but did not report any collecting over the past six months.

4. Discussion

4.1 Urban Collectors

Urban collection of wild plants plays a potentially important role in people's livelihoods. Almost half of the respondents report they have collected plant resources from the urban environment in the six months preceding the interview. Even though collection is generally conducted less than weekly, it is still an integral part of people's traditions. These results fall within the ranges reported by Davenport et al. (2011) (27-70% of all households) and Schlesinger et al. (2015) (43% for medicinal plants and 53% vegetables), indicating that the size of a town may have an influence on the quantity of plants collected, but not on the abundance of urban collectors (Davenport et al., 2011; Schlesinger et al., 2015). However, our findings show a lower number of people involved in wild plant collection compared to rural areas of Uganda, where household collection of wild plant resources is expected to be between 80% and 100% (Tugume et al., 2016).

Out of all variables tested, three indicate a significant relationship with the respondent's probability to collect wild plants: *wealth*, *age* and *location*. Respondents younger than 51 years old are more likely to collect wild plants than elderly residents of the city. This is an unexpected finding as it tends to contradict the fact that younger people who grow up in the city are less exposed to different vegetation types and have less time to learn about the usefulness of wild plants as they often attend school (Tabuti et al., 2003a) or work. However since older people generally have better traditional knowledge on wild plant use (Tabuti and Damme, 2012), this might indicate that they instruct other members of their household to collect plants for them.

Low-income households are also more likely to collect wild plants. These findings are similar to Davenport (2011), who explains that these urban commonage resources provide vital contributions to mitigating urban poverty (Davenport et al., 2011). Furthermore, Davenport (2011) found that the length of time the respondent lived in the town had a significant influence on collection practices. Our findings however, do not indicate that a rural background results in higher collection events.

It should be noted that because the present study is part of a larger study, the sample did not include households without homegardens and therefore is limited in making statements about the general (low-income) population of Kampala. It can only be hypothesized that people without access to their own plots of land are more likely to collect more from the wild.

4.2 Species collected and their use

The findings in this study indicate that medicinal plants are more often collected than food plants. Wild medicinal plants form the main source of primary health care for most Ugandans (Tabuti et al., 2003b; Tugume et al., 2016; WHO, 2002). The two most cited medicinal plants in our study, *Momordica foetida* Schumach. and *Vernonia amygdalina* Delile are both commonly used to treat malaria in tropical countries (Tugume et al., 2016). This major role wild plants have in Uganda's health care system has not gone unnoticed by the Ugandan government, who in 2015 passed a bill to upscale the use of herbal medicines and to integrate it into the main healthcare system (Uganda

Government, 2015).

In the USA, wild plant collection is mainly aimed at food plants (McLain et al., 2013; Poe et al., 2013). In urban Southern Africa, households reported to collect wild plants primarily for fuel (69%), but also for the provision of food (wild vegetables (53%); wild fruits (36%)) and medicine (43%) (Schlesinger et al., 2015). The difference in percentages of respondents who reported collecting wild vegetables is especially notable. These differences in findings could be explained through the fact that Kampala is a larger city, and that food plants are harder to find, or that pollution issues influence the quality of the plants much more and medicinal plants are safer to collect.

Furthermore, our definition of 'wild' includes a range of 'wildness', from natural generated herbs to feral crops to abandoned trees and finally to minimally managed plants within the landscape. This is in line with findings in other studies, i.e. Cruz-Garcia and Price (2014). However, it should be noted that many Ugandans domesticate local species in their gardens, thus making this already grey area of 'wildness' even greyer. Therefore, simply stating whether a plant species is wild or feral should not be based on species level, but on the plant individual level.

4.3 Location

Our study shows that both public and private lands are used as collection sites (39% and 41% respectively). Only 16% is collected from both types of locations, however in the peri-urban areas collection sites are more likely to be public spaces (e.g. roadsides and wetlands), whereas in inner urban Kampala, sites are more likely to be private spaces (e.g. neighbour's gardens and vacant plots). Respondents collecting in private gardens stated that they had permission from the residents. Moreover, the residents in the peri-urban areas are more likely to collect wild plants than other residents; this is similar to the findings of Gianotti and Hurley (2016) and Schlesinger et al. (2015). Not only is there higher biodiversity and (public) space for people to collect, they may also have reduced access to markets compared to the more centrally located urban households. In Kampala, people living in peri-urban areas generally have more traditional farming livelihoods (56% of farming population live off farming) than those in inner Kampala, where people live off wage work and business (only 18% of the farming population live off farming) (Sebastian et al., 2008). This difference in livelihoods is undoubtedly another factor influencing households' wild plant collection.

4.4 Seasonality and safety nets

Seasonality plays an important role in the use of wild food plants in people's diet outside of the harvest season when agricultural foods are expensive or not available (Agea et al., 2011b; Merode et al., 2004; Tabuti et al., 2004). We observed a peak collection activity in March when 8% of the food plant collection occurred on a daily basis. The wild collected food plants do not form a primary food source for the households included in this study. However other studies confirm that wild edible plants are not so much a replacement, but rather function as a complementary food item to diets (Boedecker et al., 2014; Termote et al., 2012).

Even though wild medicinal plants are more often collected than wild food plants, they are never collected on a daily basis and our results show less seasonal variation. These findings may indicate that food plants have seasonal peaks, based on harvest season, while medicinal plants may be collected more frequently all year round and are based on occasional need rather than seasonality (Hamilton, 2004; Tabuti et al., 2003a; Tugume et al., 2016). However this study did not cover a full calendar year, therefore it is recommended that other seasons are included in further studies to exclude recall bias (Jagger et al. 2012).

4.5 Attitudes and perceptions

In East Africa, increased intake of leafy green vegetables are often cited as a means to improve food security by providing vital nutrients (Grubben et al., 2014; Sogbohossou et al., 2015). They are fast growing, occur in many places and thus easily accessible. However not many respondents collect them as only 10 observations in total of three green leafy vegetables were reported: doodo (*Amaranthus dubius* Mart. Ex. Thell.), jjobyo (*Cleome gynandra* L.) and pumpkin leaves (*Cucurbita maxima* Duchesne). One explanation could be that since these species are of low height people avoid picking them from busy areas, such as along road sides, due to pollution risk. This is in contrast with fruits from trees (19 observations) that grow higher up, where pollution is not considered as much of a problem. In addition, fruits can often be peeled and eaten quickly, whereas (leafy green) vegetables are eaten whole and need cooking. This may explain why fruits are the majority of wild foods collected. Another explanation could be that fruit trees are more abundant in the landscape and yield many fruits at once. However, these are assumptions that need further research to be confirmed. Since our study focussed on the activity of urban collection rather than the psychology behind collection behaviour, a deeper understanding of what drives urban collectors would be recommended in future studies.

Traditional knowledge plays an important role in the collection and use of wild plant species (McLain et al., 2013; Poe et al., 2013). The findings in this study demonstrate that since wild plant species still play a role in people's lives, knowledge is still present among the urban residents. However it was beyond the scope of this study to include an in-depth analysis on the status of traditional knowledge and how it differs between urban and rural communities. Nonetheless it is worth mentioning that Tabuti (2012) found that in Uganda, cultural taboos and scepticism regarding the use of wild medicinal plants outside the local community, cause those who can afford it to choose allopathic medicine over traditional treatment methods (Tabuti and Damme, 2012). A finding that indicates that in cities, whose residents are often "outside the local community", people shun traditional treatment methods in favour of allopathic medicine. Furthermore, since the colonial period, traditional healing practices have been discouraged through the influence of 'new' religions and western education systems, causing some people to believe that the use of medicinal plants is 'devilish' (Tabuti et al., 2003a). However in our study, we did not observe a strong negative attitude that was based on cultural taboos towards the use of wild plants for medicine, and only three respondents expressed that wild edible plants were food for the poor.

5 Conclusion

In a world that is increasingly more urban, existing provisioning systems are challenged and a multi-dimensional development plan is needed (Godfray et al., 2010; The World Bank, 2015). This study contributes to addressing the knowledge gap surrounding the use of urban wild plant resources as a means to help tackle urban challenges such as food insecurity. Almost half of the respondents reported collecting wild plants in the urban and peri-urban environment of Kampala. This indicates that wild plants form a potentially important role in the livelihoods and traditions of Kampala's residents. Moreover, almost twice as many plants are collected for medicinal purposes than for food purposes. The findings in this study further indicate that residents with lower income, younger age (<51 years old), and predominantly living in peri-urban areas are more likely to be collectors of urban wild plants. This description of the current situation can help urban land planners and urban ecologists identify locations and species to incorporate in urban design. For example green zones can be incorporated into planning maps, with specific aims of providing wild plants for collection.

This type of study is beneficial to multiple disciplines and can contribute to a better understanding of food security issues, development of traditional knowledge systems and provide insights into the

relationship between urban residents and nature in order to grow sustainable cities. Whilst urban collection of plant resources can be an important strategy for poor urban households to supplement dietary and medicinal needs, it should not be overestimated as a strategy to alleviate people out of poverty (Davenport et al., 2011). Rather it could be seen as a potential safety net for those in times of economic hardship to enable them to access vital nutrients and medicines while preserving traditional knowledge systems. This means that urban collection should be part of a multidimensional economic development plan and municipalities should be aware of the importance of these urban resources for users. Even tough Kampala currently has limited public space to develop more parks and green open spaces, some possibilities have already emerged. Planned recreational and green space can form ideal locations as collection sites, as well as schools and health centres for local communities. In addition, businesses and private land owners can be encouraged to plant fruit trees for public use through small schemes. Accordingly, appropriate policies and urban land planning strategies can be developed with the objective of incorporating urban biodiversity to the benefit of urban livelihoods without compromising its sustainability.

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